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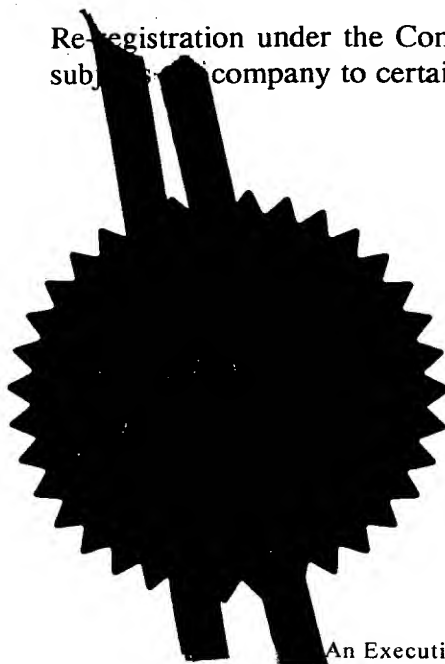
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9818188.6

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PLB/CC/N460

2. Patent application number

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3. Full name, address and postcode of the or of each applicant (underline all surnames)

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Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

BRITISH VIRGIN ISLANDS
UK

4. Title of the invention

COMMUNICATION SYSTEM, APPARATUS AND METHOD

5. Name of your agent (if you have one)

APPLEYARD LEES

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Claim(s)

Abstract

Drawing(s) 4 x 2

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IMPROVEMENTS IN AND RELATING TO ELECTRONIC
SECURITY DEVICES

Field of the Invention

5

The present invention relates to electronic security devices and to methods of operation of electronic devices.

Background to the Invention

10

Despite the growing proliferation of computer hardware and software, there are still serious problems associated with the security of both of them. Many new problems have arisen and others have become exacerbated as computers have become progressively more portable.

15

The present invention aims to provide in preferred embodiments thereof, electronic security devices that address at least some of the problems of the prior art.

20

Summary of the Invention

25

According to the present invention in a first aspect, there is provided an electronic security device comprising means for receiving and outputting signals when in an activated state, a real time clock for determining whether a predetermined real time period has expired and, if so, seeking an authorisation, means for verifying the authorisation, and means for deactivating the device in the event that a correct authorisation is not received in time.

30

This device provides time-limited security based on a real time measure, not based on the last use of the device.

35

Suitably, the device is adapted to receive encrypted authorisation codes.

5 Suitably, when not authorised the device received input signals, encrypts them and outputs the encrypted signals.

10 Suitably, the device includes means for generating a random (which expression includes pseudo-random) number and means for encrypting the random number. Suitably, the device includes means for performing a predetermined mathematical operation on the random number. Suitably, the device includes means for encrypting and decrypting data. Suitably, the encryption is according to a public
15 key algorithm.

 Suitably, the device additionally comprises a means for periodically checking the real time clock against a predetermined time period. Suitably, the periodic
20 checking means comprises a counter which upon reaching a predetermined number initiates the check and means for re-setting the counter.

 Suitably, the device comprises a dedicated power
25 supply. Suitably, the device is embodied in a plug-in module, which plug in module suitably comprises a power source such as a battery.

30 According to the present invention in a second aspect, there is provided an electronic apparatus comprising a security device according to the first aspect of the invention.

 Suitably, the security device is located between an
35 electronic output device and an electronic input device.

The output device may, for instance, be a keyboard or a modem. The input device may be a central processing unit, memory unit, video card etc.

5 According to the present invention in a third aspect, there is provided a digital electronic computer comprising a security device according to the first aspect of the invention.

10 According to the present invention in a fourth aspect, there is provided a method of operating an electronic device comprising a security device which receives output signals when in an activated state, the method comprising the steps of using a real time clock to
15 determine whether a predetermined real time period has expired and, if so, seeking an authorisation, checking whether the authorisation is acceptable and deactivating the device in the event that a correct authorisation is not received in time.

20 Suitably, the authorisation code is encrypted.

 Suitably, when not authorised the device receives input signals, encrypts them and outputs the encrypted
25 signals.

 Suitably, the device generates a random (which expression includes pseudo-random) number and encrypts the random number. Suitably, the device performs a
30 predetermined mathematical operation on the random number. Suitably, the device encrypts and decrypts data. Suitably, the encryption is according to a public key algorithm.

Suitably the encrypted number is transmitted to a verification station which verification station decrypts the encrypted number and verifies it against a number previously supplied to the electronic device.

5

According to the present invention in a fifth aspect, there is provided an electronic system operating according to the method of the fourth aspect of the invention.

10 **Brief Description of the Figures**

The present invention will now be described, by way of example only, with reference to the Figures that follow; in which:

15

Figure 1 is a schematic illustration of an electronic data processing apparatus embodying the present invention.

Figures 2A-2C are flow diagrams illustrating a mode of operation of the Figure 1 apparatus according to the present invention.

Description of the Preferred Embodiments

25 In one preferred embodiment of the present invention, there is provided an electronic data processing apparatus, typically a personal computer ("PC") 2. The PC 2 receives input signals from peripheral input devices (eg keyboard, data socket (modem), pen, voice recognition microphone etc). The PC includes a keyboard 4 having an associated
30 keyboard controller 6 and a bus 8 forming an input channel.

A security device 10 is located between the keyboard
35 controller 6 and the bus 8. The device is shown

schematically in the control line, but normally it will be located elsewhere, for instance in the body of the keyboard itself. The security device 10 has the following characteristics.

5

(i) It includes a real-time clock powered by an internal power-supply.

10

(ii) It includes a fast and reversible encryption/decryption algorithm such as DES or T-code (in ROM - read only memory).

15

(iii) It has a slower but more secure public key encryption/decryption algorithm having an associated public key (in ROM). Although referred to as a public key, it will not normally be disclosed.

20

(iv) It has a volatile memory Random Access Memory (RAM) including authorisation codes or an algorithm therefor, or pre-stored password and means for checking whether an input password or code matches such an authorisation code or password. The RAM is maintained by the power supply.

25

(v) It has the capacity to perform predetermined mathematical operations (in ROM and/or a 280 processor).

30

The security device 10 can be embodied in a board including a microprocessor (eg 280), read only memory, random access memory and a power source such as a battery to provide constant power for the real-time clock. If the

power source for the real-time clock is removed the security device 10 will become deactivated.

5 Generally, the security device 10 is activated by an activation code. The activation code is provided to the security device 10 encoded using a public key algorithm for high security. If the activation code is not provided on demand the security device 10 will enter an encryption state. The security device 10 is configured so that upon
10 receipt of the correct activation code it is activated for a period of time determined according to the activation code, according to the in-built real-time clock. The period of time can be varied based upon the activation code received. While activated, the security device 12
15 transmits received signals unaltered. When not activated it is in the encryption state and encrypts signals passing therethrough. Thus, while in the encryption state the PC 2 cannot understand the output of keyboard 8.

20 When the predetermined period of operation expires, the security device 10 requests a further activation code for the next period. The code is requested by the user from a central database. The central database checks to determine if a further activation can be approved, for
25 instance it may check to determine whether the device has been reported stolen, rental fees due have been paid etc. If further activation is authorised, the database encrypts the activation code for the next period using the particular security device's public key which is entered
30 into the security device 10. The encrypted activation code normally is provided via electronic means directly to the security device 10, for instance directly by modem or over the internet, but can also be entered manually by the user, via a disk or by local infra red transmitter. Upon
35 receipt of the encrypted activation code, the security

device 10 decrypts it and checks it against its pre-stored codes to determine the further predetermined period for which it is to be activated before requiring a further activation code.

5

Further security can be provided by an additional step of the security device 10 creating a random number which is encrypted according to the particular security devices public key. The encrypted random number is transmitted to the database centre (by whatever method). The database centre decrypts the random number, performs a predetermined mathematical calculation upon it (this could be as simple as to multiply by two or to XOR it with a key) and encrypts the new value with a public key provided (or its own public key) by the centre and sends it back to the security device 10. The security device upon receipt of the information, decrypts it using the relevant public key and compares the figures (after reversing the predetermined calculation or taking it into account). If the figures correspond then the security device 10 is confident it is dealing with the correct database centre and will accept reconfiguration instructions eg re-setting the real time clock.

25

If a correct activation code is not provided to the security device 10 on demand at the end of the predetermined period it becomes deactivated and will no longer correctly onward transmit received signals or transmit them at all. Normally, the security device 10 will demand an activation code some time prior to the end of the predetermined period of operation so that any errors or administrative difficulties can be resolved before the device becomes deactivated.

30

The PC may seek automatically an authorisation code, for instance via direct modem or internet access to an authorisation centre, without the user intervening.

5 Each PC normally will only have one such security device 10, but each such device manufactured has a different public key so each one is unique. Thus, generally each device will output a different signal upon receipt of the same input signal.

10

The device also provides password verification and can be configured to do this with or without the activation code.

15 In use, the PC 2 is configured to require a password before permitting access to certain functions or data. By way of example, a word-processing file may be password protected. Before permitting access to the file, the PC Central Processing Unit (CPU) requires confirmation from
20 the security device 10 that the correct password has been entered.

Referring to Figures 2A-2C of the drawings that follow, there is shown a flow diagram of the operation of
25 the present invention. The flow diagram shows a system configured to require correct password input for operation from power up and when a predetermined time period expires.

30 Referring now to Figure 2A, from power up 100 the security device 10 checks (101) a flag to determine whether it is its first power up in which case a configuration set-up is initiated (103). In CONFIGURATION
35 the device is allocated its unique public key and the real-time clock is initialised. Other features such as

its predetermined mathematical operation, codes for certain time periods, etc can be configured or modified at this time. When configuration is finished or following the "password tamper count" is checked 102. At 104 if the
5 tamper count is greater than the default tamper count a "LOCKED" message is displayed 106 and the security device 10 is configured into a "PASSWORD LOCKED WAITING" state (see Figure 2B) at 108.

10 If at 104 the tamper count is less than or equal to the default tamper count a password is requested 110. If at 112 the password is incorrect the tamper count is incremented by one 114. Otherwise, if the password is correct the security device 10 compares the current real
15 time with the time against which activation has been permitted 116. If at 118 the time has expired, the security device is configured into the "LOCKED WAITING" state 120 (see Figure 2C) but if the time has not expired the information is passed without interruption (122).

20 Referring to Figure 2B, the "PASSWORD LOCKED WAITING" state is now described.

In the "PASSWORD LOCKED WAITING" state 108, at 124
25 the user is required to input a command instructing the PC to communicate with an authorisation centre. At this stage the user can choose manual or automatic communication with the authorisation centre. When the command is entered, the tamper count is incremented (126).
30 If (128) the tamper count has expired the device is locked (130). If the tamper count has not expired, the device is allowed (132) to operate for a further 3-4 hours to enable the verification procedure to be completed.

The security device first creates and encrypts a random (or pseudo-random) number and encrypts it with the embedded public key (134). The encrypted random number is transmitted to the authorisation centre which may be
5 automatic, for instance via a direct modem or the internet, or manually, for instance by the user phoning up the authorisation centre and entering what they are told via the keyboard. If the user communicates manually, further security can be implemented such as checking the
10 users pre-allocated password etc.

The security device 10 then at 136 enters a waiting state to receive a data string (138) from the authorisation centre which it decrypts. If the received
15 data is verified (140) the "wrong password tamper count" is incremented (142) and the device is permitted to operate for a further period with a new password that is notified to the user (144). The input from the authorisation centre includes an activation code and a new
20 password encrypted according to the public key of the security device 10. If at 140 there is an error, indicating perhaps an attempted tampering with the device, it returns to the "PASSWORD LOCKED WAITING" state and asks for a command to be entered.

25 The authorisation centre will only provide the security device 10 with the necessary authorisation code and new password if approved. Approval may depend upon payment of relevant fees to the authorisation centre, checking whether the item of equipment is registered as
30 stolen, or other security checks.

Referring to Figure 2C the security device 10 is in the "LOCKED WAITING" state 120. As this state is

indicative of a possible security breach, a higher level of security is adopted.

At 146 the security device 10 requires a command to
5 be entered instructing it to communicate with the
authorisation centre via modem (for instance). Upon
receipt of the command 148, the tamper count is checked
150. If the tamper count is less than or equal to the
DEFAULT valve the ALLOW TAMPER COUNT counter is
10 incremented 152 and the device is authorised 154 to
operate for 3-4 hours from then until the user downloads
an acceptable activation code. Next, or if at 150 the
ALLOW TAMPER COUNT is greater than the default value, at
156 the security device 10 creates a random (or pseudo-
15 random) number which is encrypted using its public key.
The encrypted random number is transmitted to the
authorisation centre together with an identifier of the
security device 10 in question.

20 The security device 10 then enters 158 a waiting
state during which it expects to receive a data string
from the authorisation centre for activation. The
authorisation centre first checks whether the security
device 10 can be authorised for a further period, for
25 instance by checking whether it has been reported stolen
or if any monies due are outstanding. If further use can
be authorised, the authorisation centre (knowing the
public key of the security device 10) decrypts the
encrypted random number, performs a predetermined
30 mathematical operation upon it (eg XOR or multiply), re-
encrypts the result using the same public key and
transmits the encrypted result with an encrypted new
authorisation code to the security device 10 as a data
string.

Upon receipt 160 of the encrypted data string, the random number is checked 162 (since the security device 10 knows the predetermined mathematical operation undertaken by the authorisation centre) and if verified the ALLOW
5 TAMPER COUNT is incremented by one 164 and the device is authorised (166) for a further 3-4 hours until the user downloads a good activation code.

If the data is incorrect, a communication command is
10 requested 146 once again.

Once in normal operation the device 10 uses a counter to count up to a predetermined value at which point the real-time clock is checked against its memory for
15 authorisation of a further period. After each check the counter is re-set and counts again. Thus, the real-time clock is checked periodically against the permitted time of operation to determine if further authorisation is required.

20

Further embodiments of the present invention provide the security device 12 before a hard disk or other memory device in a PC architecture.

25 In this mode, the device encrypts signals input to the hard disk or other memory device and decrypts signals output from the same. This makes theft of data from the hard disk or other memory device harder, especially when the mode is combined with the feature described below. We
30 refer to this as Auto-Encrypt On Demand Decrypt (AEODD).

The device can be placed before any essential integer of the PC, such as the hard disk, the CPU, the video card etc and configured so that it will only operate upon
35 periodic receipt of an authorisation code. When correctly

activated the device onwards transmits received signals. If it is deactivated it blocks received signals. Alternatively, in the case of a memory device, encryption and decryption can be provided.

5

In each case, the provision of the device means that unless it is correctly activated the PC cannot properly be used. For instance, in the case of the hard disk option, everything that is written to the hard disk is encrypted
10 (providing additional security to the data on the disk) using the fast encryption algorithm and everything read from it is decrypted by the device. The decryption only occurs if the device is activated so if the PC is stolen, then when the permitted time period expires no further
15 authorisation can be obtained (with the assumption that the PC has been reported as stolen), so in effect it will become inoperative. Since activation relies on the public key encryption code, it is relatively secure. Equally, if the device precedes the CPU or video card, if it becomes
20 deactivated, the PC is inoperative.

Deactivation of the security device can be by configuring it so that it no longer transmits signals upon deactivation, but the present invention is not limited to
25 this alternative. Deactivation can also be achieved, for instance, by configuring the device to output a useless signal, for instance an encrypted version of the input signal.

30 Although reference is made herein to a "password", that can comprise any signal or combination of signals and need not be a "word" at all.

It will be appreciated by those skilled in the art
35 that the device can be located in other positions or,

preferably, incorporated integrally within an essential element of the PC.

5 In a preferred embodiment of the present invention a microprocessor security device is provided with a real-time clock on a PC motherboard at a vital point, such as prior to the CPU, the video card, the hard disk etc. When correctly activated, the device receives and outputs received signals. The device remains activated for a
10 predetermined period of time. Upon or just prior to expiry of the predetermined period, the device seeks an authorisation code that can be input to it in any of the known ways. If a correct authorisation code is not entered, the device is deactivated and no longer properly
15 outputs received signals. Thus a periodic authorisation code is required to keep the security device, and hence the PC, operational.

20 In preferred embodiments, the authorisation code is provided in encrypted form and, if desired, a further authentication step can be carried out.

25 The invention is applicable to any electronic apparatus. Although the present invention is described in relation to a PC, it will be appreciated that in relation to the periodic activation code feature it can find application in any electronic apparatus, for instance a video camera, lap top computer, mobile telephone etc.

30 The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers
35 and documents are incorporated herein by reference.

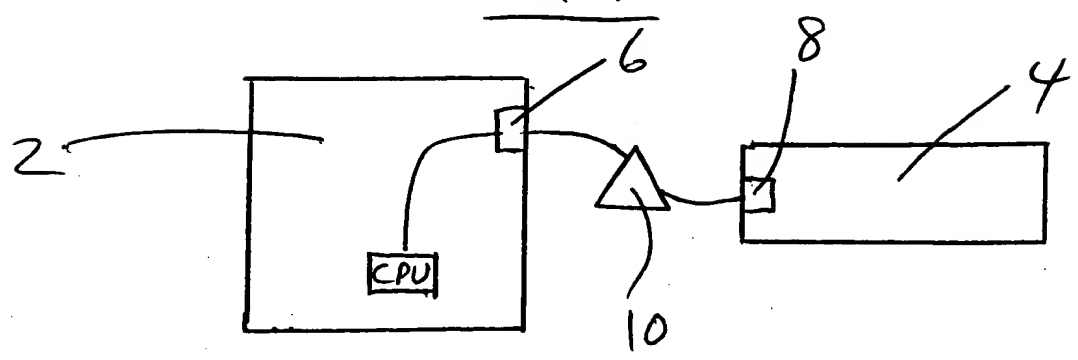
All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

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The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

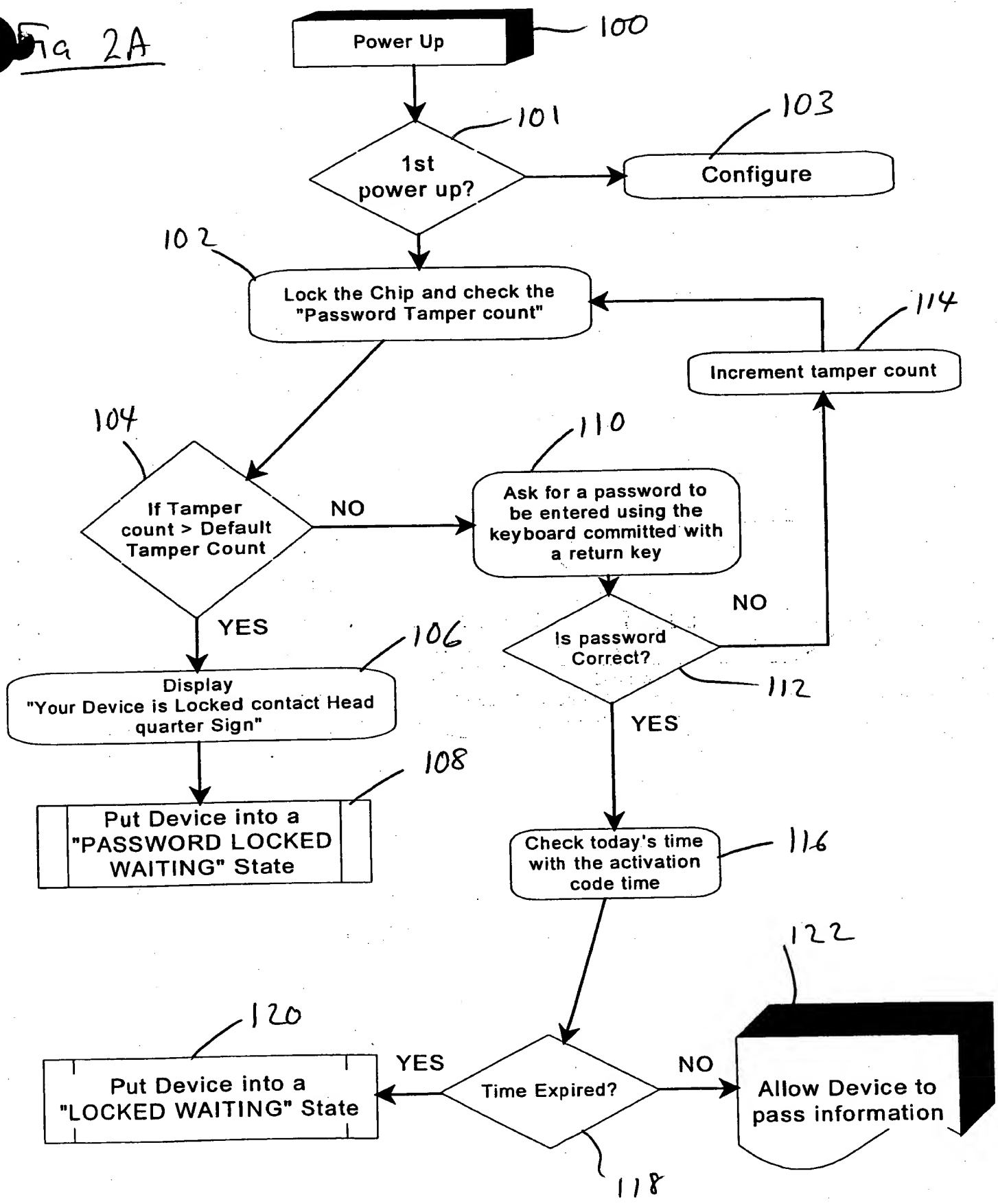
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Fig 1



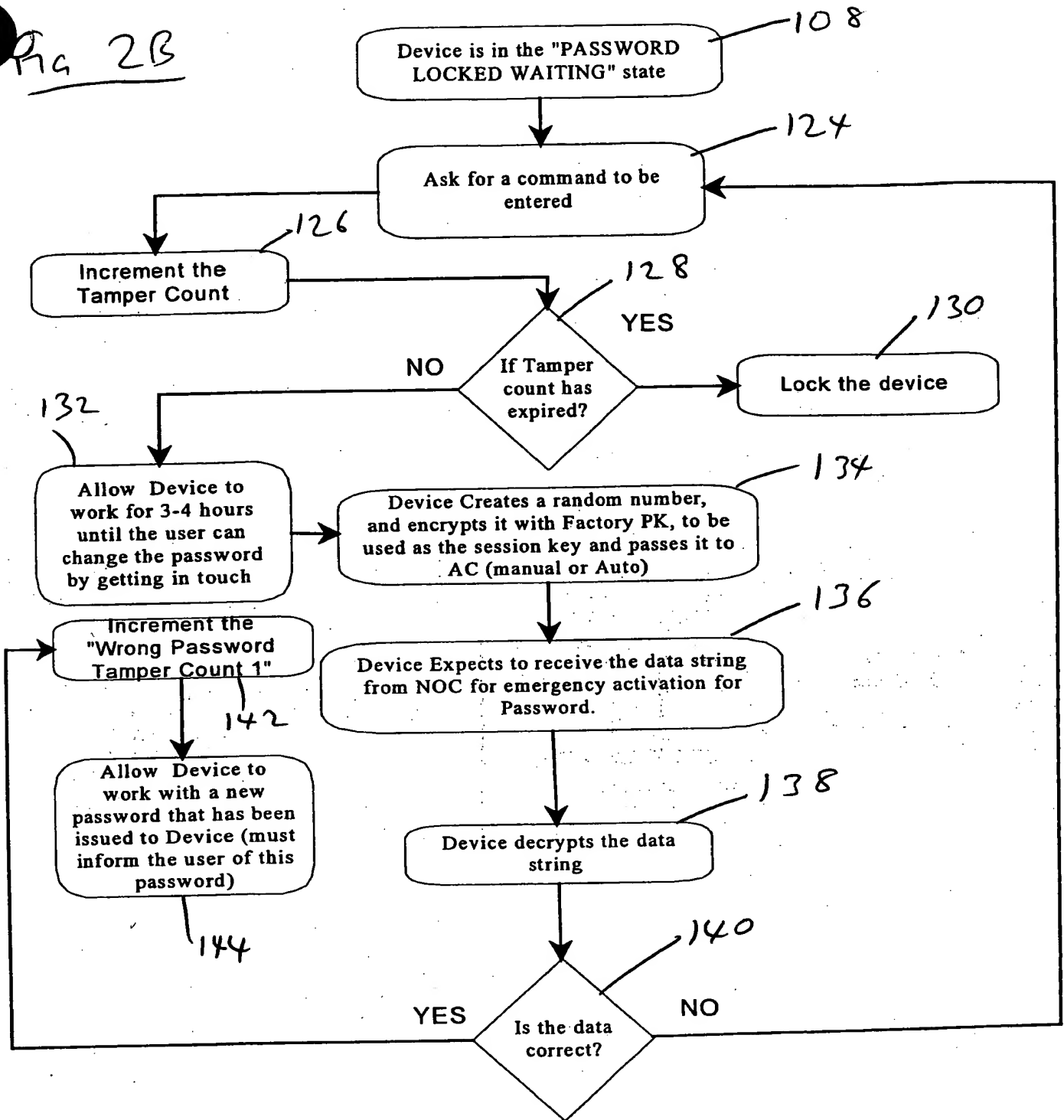
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Fig 2A



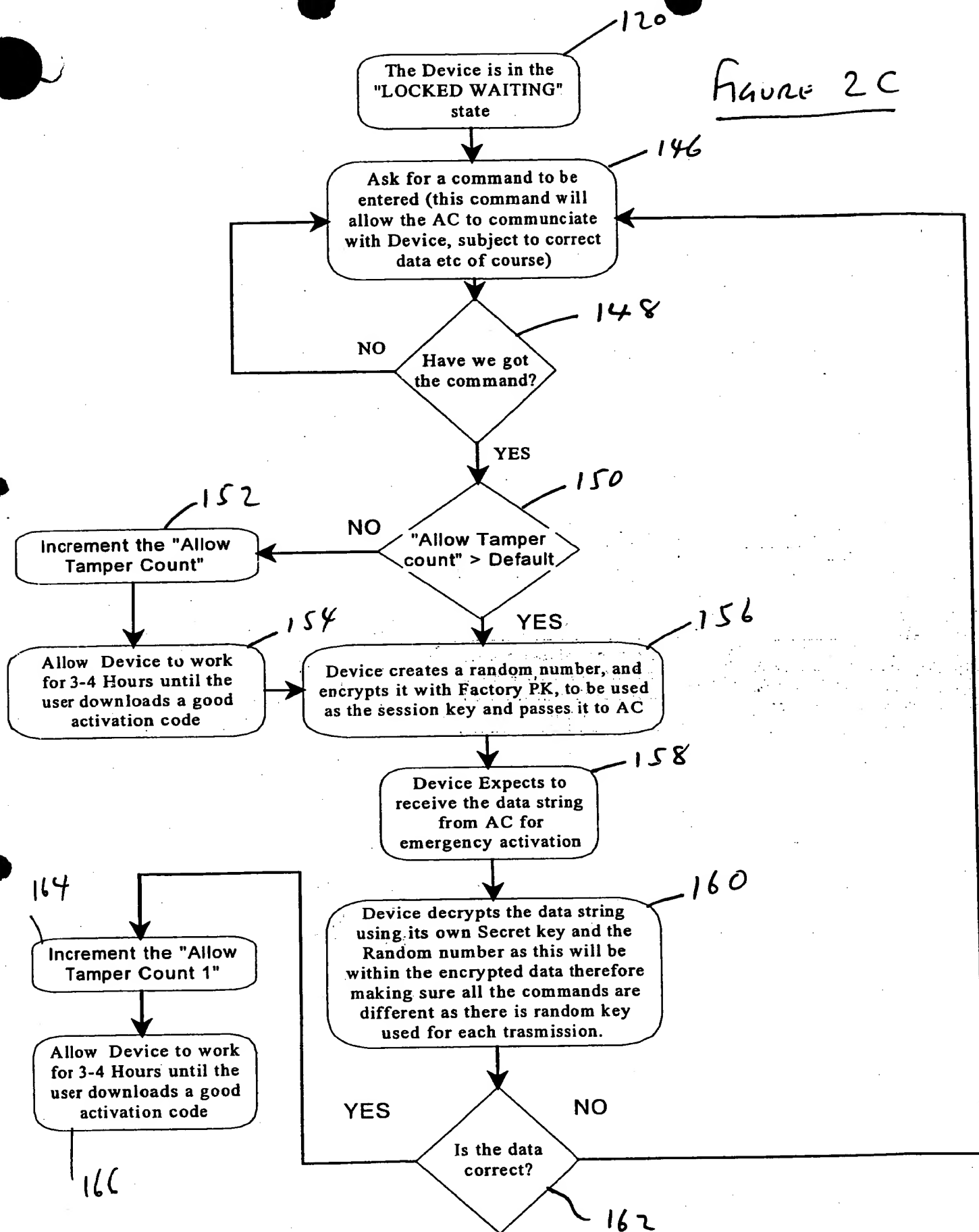
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Fig 2B



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Figure 2C



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